

# *The People's Republic of China*

## EDICT OF GOVERNMENT

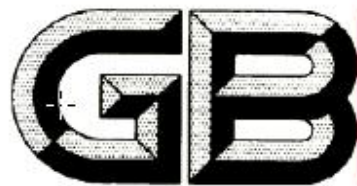
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GB 24429 (2009) (English): Sports helmets -  
Safety requirements and testing methods for  
sports helmets for cyclists and users of  
skateboards and roller skates



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# **National Standard of the People's Republic of China**

GB xxxx-xxxx

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## **Sports helmets - Safety requirements for sports helmets for cyclists and users of skateboards and roller skates**

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## Foreword

Clause 5, Clause 6, Article 7.1 and Clause 8 of this Standard are mandatory, whilst the rest are recommended clauses.

The technical requirements and test methods specified in BS EN1078:1997 and F1447-06 are adopted as the main technical requirements and test methods of this Standard. The clauses of this Standard and the clauses in the normative standard correspond to each other as follows:

- Article 5.2.2 of this Standard corresponds to Article 4.3 of BS EN1078:1997;
- Article 5.2.3 of this Standard corresponds to Article 4.6.6 of BS EN1078:1997;
- Article 5.2.4 of this Standard corresponds to Article 4.6.5 of BS EN1078:1997;
- Article 5.2.5 of this Standard corresponds to Article 10.2 of F1447-06;
- Article 6.4 of this Standard corresponds to Article 5.7 of BS EN1078:1997;
- Article 6.5 of this Standard corresponds to Article 5.6 of BS EN1078:1997;
- Article 6.6 of this Standard corresponds to Article 5.5 of BS EN1078:1997;

The aim of drawing up this Standard is to ensure that helmets manufactured according to this Standard, in actual use, protect the safety of the wearer's head to the greatest possible extent. Each test aims to ensure the strength of the helmets.

This Standard is proposed by China National Light Industry.

This Standard is under the jurisdiction of the China Station & Sporting Goods Standardization Centre.

The main organisations that participated in the drafting of this Standard are:

China State Sporting Goods Quality Control & Inspection Centre;  
Hebei Provincial Product Quality Supervision & Inspection Institute;  
Shunde Moon Helmet Co., Ltd. (Foshan);  
Kylin Motorcycle Fitting Co., Ltd.;  
Zhuhai Tailian Sports Equipment Co., Ltd.

The main drafters of this Standard are:

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# **Sports helmets - Safety requirements for sports helmets for cyclists and users of skateboards and roller skates**

## **1 Scope**

This standard specifies the terms and definitions, specifications, requirements, test methods, marks, packaging, transportation, storage and instructions for helmets for pedal cyclists and users of skateboards and roller skates.

This standard applies to the helmets worn by cyclists, skateboarders and roller skaters.

## **2 Normative references**

The provisions of the following documents become provisions of this Standard after being referenced. For dated reference documents, all later amendments (excluding corrigenda) and versions do not apply to this Standard; however, the parties to the agreement are encouraged to study whether the latest versions of these documents are applicable. For undated reference documents, the latest versions apply to this Standard.

GB/T 10000 Human dimensions of Chinese adults

## **3 Terms and definitions**

The terms and definitions listed below apply to this Standard.

### **3.1 Sports helmet (hereinafter referred to as helmet)**

Sports helmet is referred to as the headgear used during sports activities to absorb the force encountered on impact, to reduce the risk of unintentional head injuries to the wearer of the helmet.

### **3.2 Shell**

The outer surface structure of a helmet.

### **3.3 Cushion coat**

The layer of cushion that fits around the head which is used to absorb the encountered impact force.

### **3.4 Comfort pad**

The pad used to ensure the proper fit of a helmet to the wearer's head.

### **3.5 Retention system**

The complete assembly by which the helmet is retained in position on the head during use. The system includes the adjustment system and straps etc., which provide more comfort to the wearer of the helmet.

### **3.6 Strap**

Part of the retention system, the strap which is tied down under the lower jaw of the helmet wearer,

used to secure the helmet.

### 3.7 Basic plane

A plane through the centres of the left and right external ear openings and the lower edge of the eye sockets. See the 0-0' plane shown in Diagram 1.

### 3.8 Reference plane

A plane above and parallel to the basic plane, at a distance (X) from the basic plane. This distance (X) is determined by the model size of the headform. See Diagram 2 and the stipulations of Table 1.

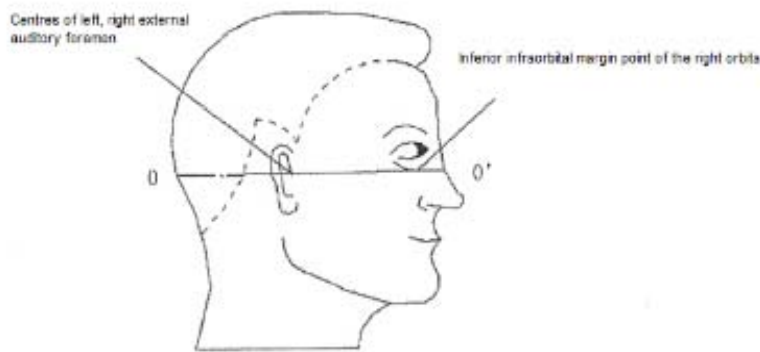


Diagram 1 Side view of the basic plane (0-0')

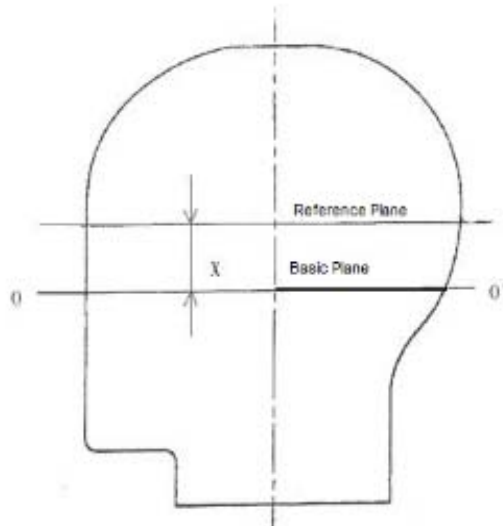


Diagram 2 Reference Plane and Basic Plane

**Table 1 Distances and protection range dimensions between different specific dimensioned basic planes and reference planes Unit: mm**

Specification size	X	L/2	Y	R	S	T	U
Extra small	23	85	87	38	24	142	80
Small	25	90	95	39	25	147	84
Medium	27	95	103	40	26	153	87
Large	30	100	110	41	27	158	90

### 3.9 Test area and protection range

The inspection range on the helmet when the helmet is undergoing the impact test. It is consistent with the minimum protection range of the head (the area above the ABCDEF lines). See Diagram 3 and Table 1.

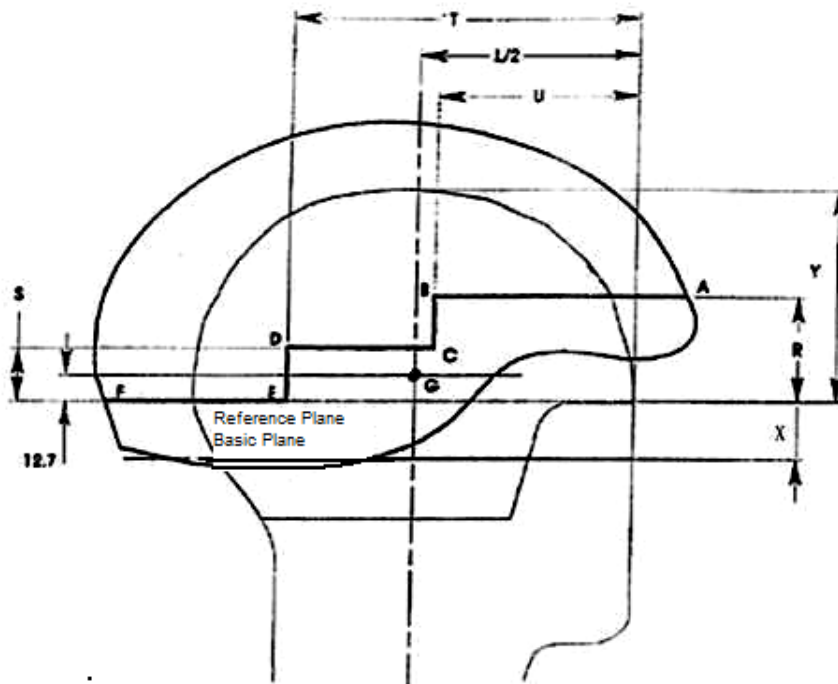


Diagram 3 Test area and protection range



## 4 Specifications

According to the provisions set out in GB 10,000, and the head circumference dimensions of minors, helmets are divided into four sizes: Large, Medium, Small, and Extra Small. See Table 2.

**Table 2 Helmet sizes**

<b>Specification size</b>	<b>Head circumference dimensions, mm</b>
Extra small	500 ~ 540
Small	540 ~ 560
Medium	560 ~ 580
Large	580 ~ 600

The head circumference dimension for extra small helmets is allowed to be 40 mm smaller than the maximum circumference of the head size prescribed in Table 3. The head circumference dimensions for other size helmets are allowed to be 20 mm smaller than the maximum circumference of the head.

## 5 Requirements

### 5.1 Structures

A helmet consists of a shell, cushion coat, comfort pad and retention system, etc.

#### 5.1.1 Shell

The shell must conform to the following:

- a) made of tough textured, water resistant, heat resistant and cold resistant materials;
- b) the surface of the shell should be solid and smooth, the shell edge should be round and blunt, to prevent direct head injuries;
- c) during the tests mentioned in this Standard, there should be no ruptures on the shell to endanger the wearer;
- d) projections outside of any helmet's shell should not protrude more than 7 mm (objects which can easily fall off are excluded);
- e) ventilation holes may be provided.

#### 5.1.2 Cushion coat

The cushion coat must conform to the following:

- a) made of materials which can absorb the encountered impact energy better and the materials must not be affected by contact with sweat or cosmetics;
- b) the shapes and specification sizes should be properly fitted and the cushion coat must not move when the helmet is worn; there should not be any projection of over 2 mm and no sharp object on the inner surface;
- c) should cover the minimum protection area of the head specified in 3.9 and Diagram 3;

- d) ventilation holes may be provided.

### **5.1.3 Comfort pad**

The comfort pad must conform to the following:

- a) materials for the comfort pad should be comfortable to wear, be able to absorb sweat and allow ventilation. The materials must not be affected by contact with sweat or cosmetics;
- b) materials and adhesives which can cause skin irritation must not be used;
- c) ensure that the helmet is comfortable to wear.

### **5.1.4 Retention system**

All components of the retention system should be safely and securely fitted onto the helmet and should meet the following requirements:

- a) the width of the strap should not be less than 15 mm;
- b) the adjustment system and retention system for tension tightening should be fitted. This system should be able to adjust the strap fastener so that it is not positioned on the lower jawbone;
- c) the retention system should be able to be unlocked where pressure is applied with one hand.

### **5.1.5 Protection range**

Helmet must be able to cover the area above the ABCDEF lines in Diagram 3.

## **5.2 Performance**

### **5.2.1 Mass of helmet (including accessories)**

The mass of any helmet should be: nominal factory value  $\pm$  30g

### **5.2.2 Visual field of helmet**

The left and right horizontal visual field of any helmet must not be smaller than 105°, the upper visual field must not be smaller than 25° and the lower visual field should not be smaller than 45°.

### **5.2.3 Stability of helmet retention system**

The helmet must not fall off from the headform.

### **5.2.4 Strength performance of helmet retention system**

The dynamic elongation of the retention system must not exceed 35 mm, its static elongation must not exceed 25 mm and anomalies such as the strap tearing free, the fastener falling off or the fastener becoming loose should not happen.

### **5.2.5 Performance of helmet absorbing encountered impact energy**

The peak acceleration should not exceed 300 g.

## **6 Test methods**

### **6.1 Laboratory environmental conditions**

Temperature should be  $20\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ , relative humidity should be 25% ~ 75%.

### **6.2 Helmet structures, specification sizes, inspection for protection range inspections and contents checking of marks**

#### **6.2.1 Inspection instruments**

A dimensional measuring instrument with division value not exceeding 0.5 mm, and standard headforms of large, medium, small and extra small.

#### **6.2.2 Inspection procedures**

- a) Check the conditions of the structure, appearance and mark statues etc. of the helmet by sight.
- b) Use the measuring instrument to check the strap and the inner, outer surfaces etc. of the helmet.
- c) Measure the specification sizes and the protection area of the helmet, place the helmet onto the corresponding size standard headform. Adjust the retention system and apply a 5 kg load onto the top of the helmet, measure the protection area of the helmet and mark the test area.
- d) The inspection result should conform to the requirements specified in Clause 4, Article 5.1 and Article 7.1.

### **6.3 Inspection of helmet mass**

#### **6.3.1 Inspection instrument**

A weight measuring instrument with division value not exceeding 5 g.

#### **6.3.2 Inspection procedures**

- a) Weighing the helmet (including accessories), record as g (grams);
- b) The inspection result should conform to the requirement specified in Section 5.2.1.

### **6.4 Inspection of visual field of helmet**

#### **6.4.1 Inspection system**

The inspection system consists of an angle scale, test headforms and a fixation frame to secure the headforms. The division value should be  $1^{\circ}$  and the measurement range may meet the requirements specified in Section 5.2.2.

## 6.4.2 Inspection procedures

According to the procedures specified in Section 6.2.2 (c), place the helmet correctly onto the test headform:

- a) Left and right horizontal visual fields: two dihedral angles are formed by the longitudinal vertical centre plane and the left right two symmetry direction planes which form an angle not smaller than  $105^\circ$ , located between the reference plane and the basic plane, its boundary is the straight line LK. See Diagram 4:

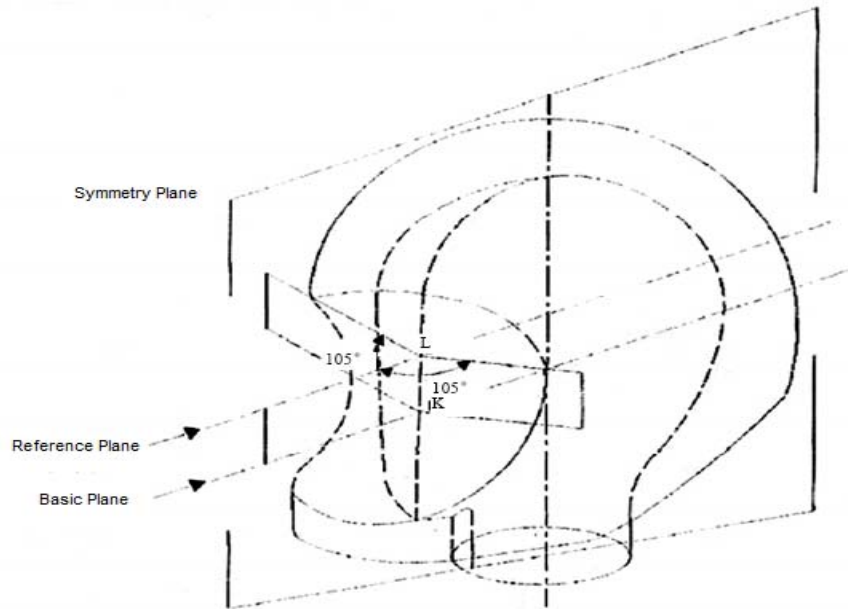
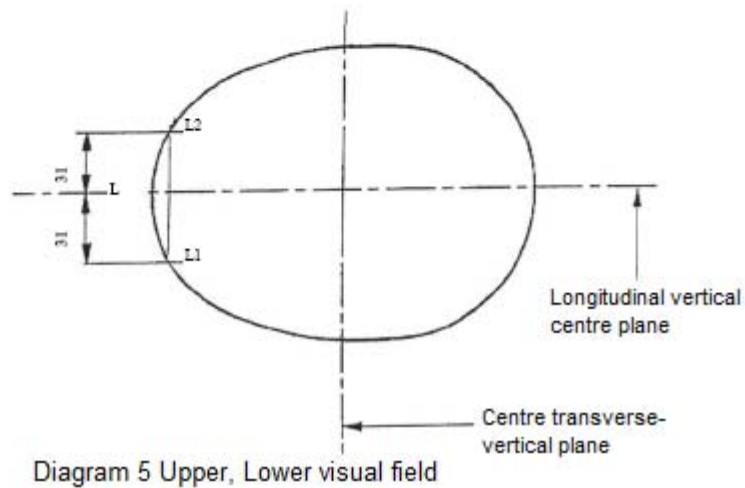
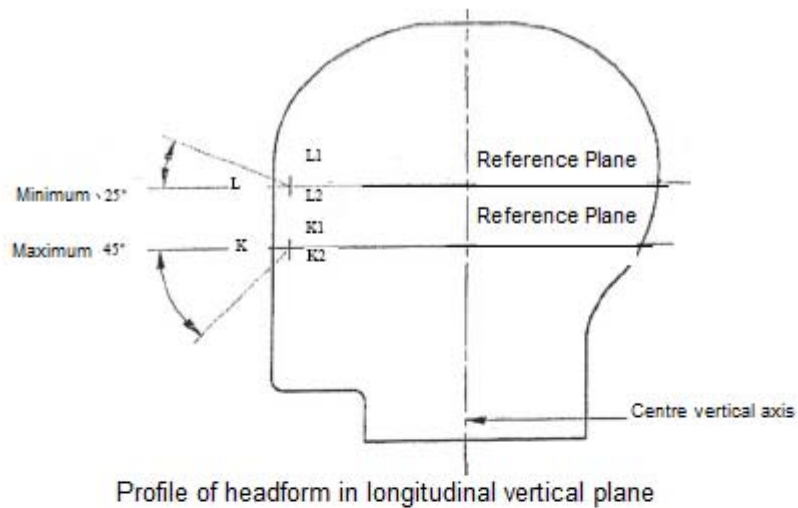


Diagram 4 Left and Right horizontal visual field

- b) Upper visual field: dihedral angle is formed by the reference plane of the test headform and an upwards plane which forms an angle not smaller than  $25^\circ$ , its boundary  $L_1L_2=31+31=62$  mm, see Diagram 5;
- c) Lower visual field: dihedral angle is formed by the basic plane of the headform and an upwards plane which forms an angle not smaller than  $45^\circ$ , its boundary  $K_1K_2=31+31=62$  mm, see Diagram 5;
- d) The inspection result should conform to the requirements specified in Section 5.2.2.



## 6.5 Stability test for the retention system of helmets

### 6.5.1 Test equipment

Consists of a base, test headforms, drop weight (mass of  $10.0 \text{ kg} \pm 0.1 \text{ kg}$ ), a guiding unit (total mass of  $3.0 \text{ kg} \pm 0.1 \text{ kg}$ ), a release unit, a pulley, an elastic belt (under a load of  $1000 \text{ N}$ , its elongation should be lower than  $18 \text{ mm/m}$ ), as shown in Diagram 6.

### 6.5.2 Test procedures

- According to the procedures specified in Section 6.2.2 (c), place a helmet correctly on a suitable test headform, secure the strap.
- As shown in Diagram 6, the hooks of the guide unit and the release unit should be connected to the centre of the back of the helmet.
- The drop weight should be released from a height of  $175 \text{ mm} \pm 5 \text{ mm}$ , allow the drop weight

- to free fall along the guide rail of the guide unit, drop onto each helmet once.
- d) The test result should conform to the requirements specified in Section 5.2.3.

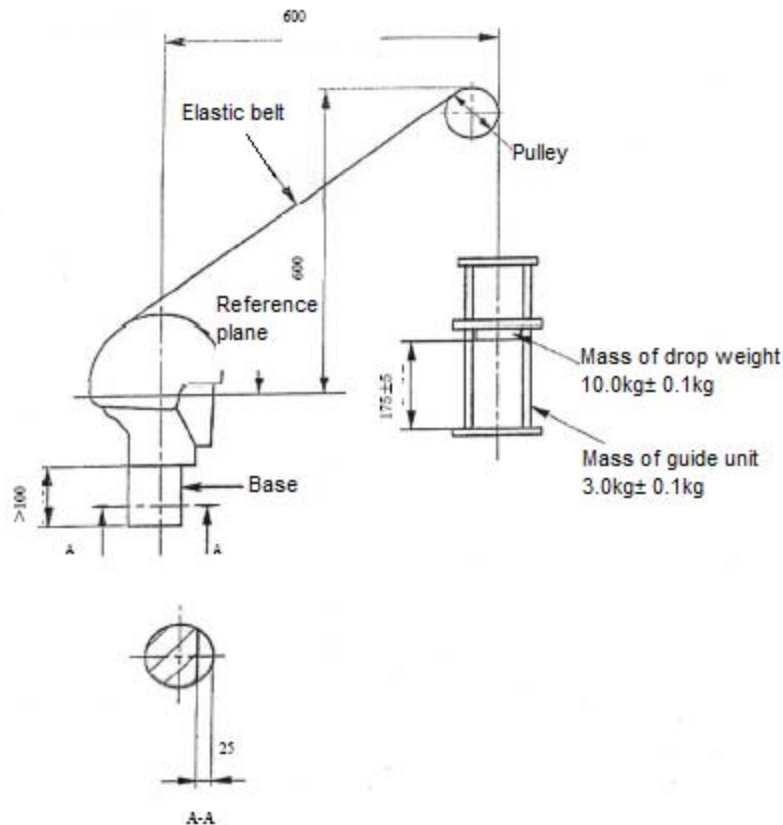


Diagram 6 Stability test bench for retention system

## 6.6 Strength test for the retention system of helmets

### 6.6.1 Test equipments

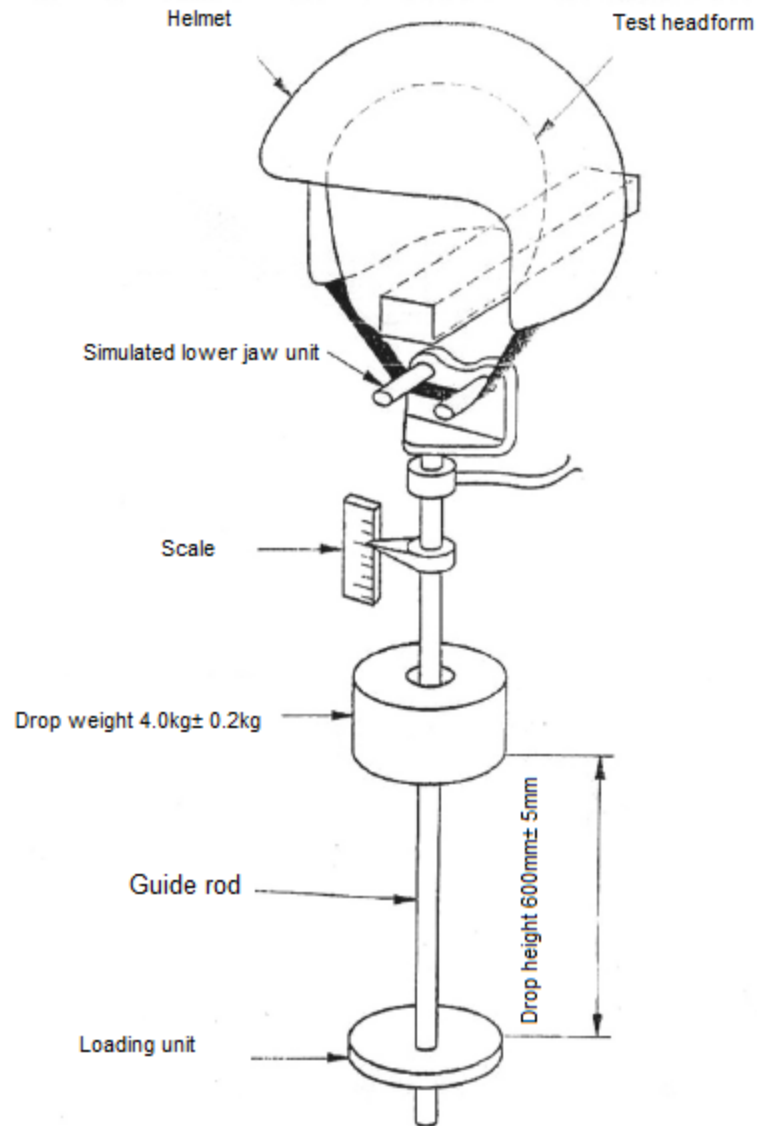
Consists of a fixation frame, test headforms, drop weight (mass of  $4.0 \text{ kg} \pm 0.2 \text{ kg}$ ), a scale, loading unit (total mass of  $5.0 \text{ kg} \pm 0.5 \text{ kg}$ ), simulated lower jaw (width should be  $87 \text{ mm} \sim 90 \text{ mm}$ ) etc. as shown in Diagram 7.

### 6.6.2 Test procedures

- According to the procedures specified in Section 6.2.2 (c), place a helmet correctly onto a suitable test headform, firmly secure the strap over the simulated lower jaw, allow the loading unit (total mass of  $5.0 \text{ kg} \pm 0.5 \text{ kg}$ ) to free action on the retention system for 30 s and thus determine the initial zero setting of the scale;
- When it is secured, release the drop weight, allow it free fall from a height of  $600 \text{ mm} \pm 5$

mm and impact onto the end baffle plate;

- c) Use the scale to measure the maximum dynamic displacement of the simulated lower jaw and the residual displacement after two minutes in order to determine the corresponding prolongation of the retention system;
- d) The retention system should be able to be unlocked where pressure is applied with one hand;
- e) The test result should conform to the requirements specified in Section 5.2.4 and Section 5.1.4 (c).



## 6.7 Performance test for impact energy absorption of helmet

### 6.7.1 Test equipment

The test equipment consists of an impact test bench and an analysis recorder. The equipment should conform to Sections 5.2.5, 6.7.1.1, 6.7.4.1 and 6.7.4.2 and meet the requirements related to ensure

the impact energy is consistent with the impact efficiency.

### 6.7.1.1 Impact test bench

The impact test bench consists of falling guiding unit, headforms, fixation frame to secure the headforms, spherical joint, anvil, anvil base, release system and base as shown in Diagram 8.

The main parts of the test bench should meet the following technical requirements:

- a) Headforms: made of metal materials and with a similar structure to the frequency response of the human head. The frequency response should be below 1400 Hz and the minimum resonance frequency should be 2500 Hz. The headforms are divided into four sizes: extra small, small, medium and large (see Table 3 and Diagram 9). The total mass of the dropping headforms (including the acceleration transducer and the connector) are as follows: extra small size should be  $4^{+0.1}_0$  kg, small size should be  $4^{+0.1}_0$  kg, medium size should be  $5^{+0.1}_0$  kg and large size should be  $6^{+0.1}_0$  kg. Among which, the mass of the acceleration transducer and the connector should not be more than 25% of the total mass of the dropping headform. An accelerator transducer should be fitted at the centre of the gravity of the headforms.
- b) The anvil and the anvil base: The anvil should be made of tool steel (TIOA). The roughness of the impact surface should not be lower than Ra 0.8 and the hardness should not be lower than HRC 50. The anvil and the anvil base should be rigidly connected, the anvil base should be rigidly fixed onto the base and the collision surface must be perpendicular to the normal line of the impact point of the headform.

Flat anvil: should be constructed of a steel plate with a diameter of  $130 \text{ mm} \pm 3 \text{ mm}$  and a minimum thickness of 15 mm as shown in Diagram 10.

Curbstone anvil: the curbstone anvil has two sides intersecting at the impact edge and forming an angle of  $105^\circ \pm 0.5^\circ$ , the height should be  $50^{+2}_0$  mm and the length should be  $125^{+2}_0$  mm; as shown in Diagram 11.

- c) Base: made of reinforced concrete, the mass should be lower than 1600 kg.

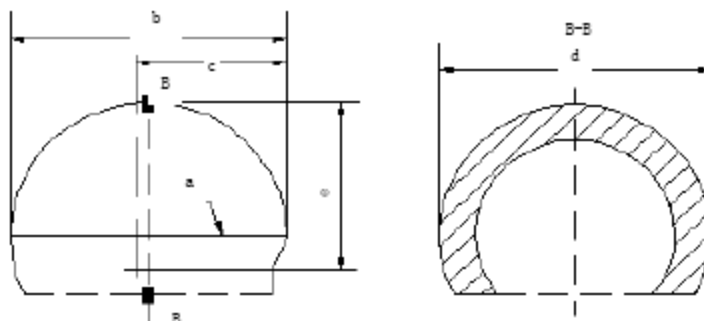


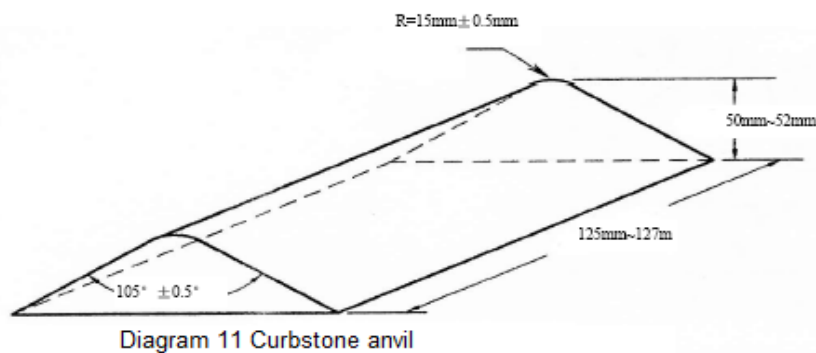
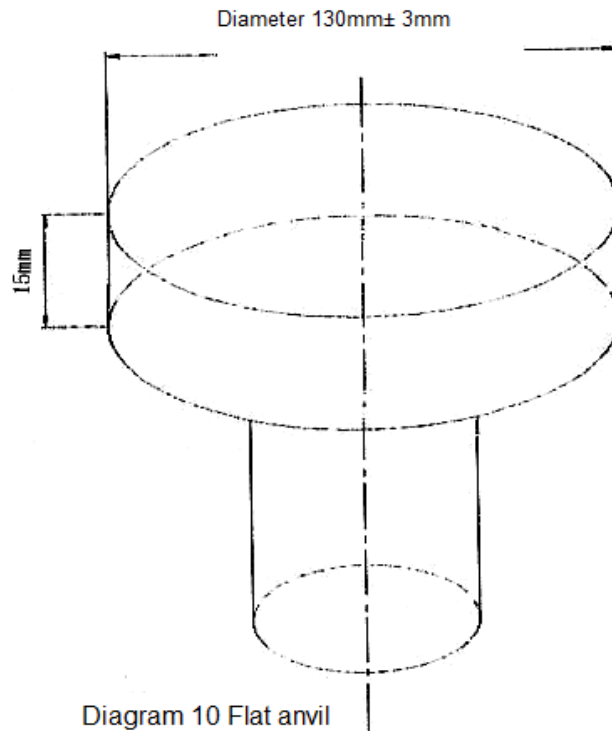
Diagram 9 Headform

Table 3 Dimension of headforms

Symbol	Name	Model sizes				Margin of error
		Extra small	Small	Medium	Large	
a	Maximum	540	560	580	600	$\pm 2$



	circumference of the head				
b	Head length	170	180	190	200
c	Ear-forehead space	95	100	105	110
d	Head width	145	155	166	177
e	Ear-head height	110	120	130	140



### 6.7.1.2 Test for analysis recorder system

The analysis recorder system consists of a single-axis acceleration transducer, an amplifier, data processing, displaying and recording etc. Its main performance requirements are as follows:

- a) the range of the frequency response should be  $0^{+0.2}_0$  Hz ~ 1000 Hz, the cut-off point for frequency band should be  $-3^{+0.5}_{-1}$  dB, the subsidence frequency should be -9 dB/oct ~ -24 dB/oct;

- b) meet the detection requirements for acceleration value mentioned in Section 5.2.5;
- c) measure the uncertainty  $U=5\% (k=2)$ .

### 6.7.2 Treatment of helmet sample before test

Helmet samples must undergo treatment in accordance with the requirements specified in Table 4. Select only one treatment for each helmet sample.

Helmet samples undergoing the hot or low temperature treatment should complete the test within 3 minutes after the treatment; if the helmet has left the treatment environment for more than 3 minutes, then it should be put back into the incubator for a minimum of a further 5 minutes of re-treatment before undergoing the test. For helmet samples undergoing water-immersion treatment, the sample should be air dried for 20 minutes before the sample undergoes the test.

Table 4 Helmet treatments before test

Item	Condition	
	Temperature, °C	Duration, h
High temperature	$50 \pm 3$	4 ~ 24
Low temperature	$-15 \pm 2$	4 ~ 24
Water-immersion	15 ~ 23	4 ~ 24

### 6.7.3 Test area and impact points

#### 6.7.3.1 Test area

The test area is the part which is above the prescribed lines of ABCDEF in Diagram 3 (see Diagram 3 and Table 1).

#### 6.7.3.2 Impact points

Choose 4 weakest places at random within the test area as the impact points, carry out one impact to each impact point, out of which use the flat anvil for two impact points and the curbstone anvil for the other two impact points (along the length and width of the ventilation hole for one impact each), the space between two impact points should not be less than 120 mm. See Table 5 for the impact velocity and number of impacts.

Table 5 Test conditions for the performance of impact energy absorption of helmet

Velocity, m/s	Flat anvil	6.2
	Curbstone anvil	4.8
Number of impacts on a same impact point		1
Impact velocity is determined 40 mm before the impact, not less than 95% of the theoretical velocity.		

## **6.7.4 Test procedures**

6.7.4.1 Fix the acceleration transducer rigidly onto the centre of gravity of the headform. The angle between the sensitive axis of the acceleration transducer and the normal line of the impact point of the headform must not exceed 5°.

6.7.4.2 Calibrate the impact test unit: adjust the impact velocity of the headform of the impact test bench, cause it to impact with the standard test block at a velocity of 5.44 m/s (measured 40 mm before the impact). Under the same conditions, conduct three impacts with a time interval of 75 s ± 15 s between each. The error for peak acceleration of each impact should not exceed 3%; conduct one calibration before and after the test respectively. If the difference between the peak values of the mean acceleration before and after the test is greater than 5%, then the result of this test is invalid.

6.7.4.3 Place an environmentally treated helmet correctly onto a suitable corresponding size test headform. Locate the impact point in the test area of the helmet, fasten the strap securely and carry out the test in accordance with the requirements specified in Table 5.

6.7.4.4 The test result should conform to the requirements specified in Section 5.2.5 and Section 5.1.1 (c).

## **7 Marks, packaging, transportation and storage**

### **7.1 Marks**

The following information should be permanently marked onto each helmet so that it can be seen during the entire service life of the helmet:

- a) product name;
- b) name and address of the manufacturer;
- c) product usage;
- d) product specification and model number;
- e) manufacturing date, batch number or serial number of the product;
- f) standards compliance;
- g) helmet mass (g);
- h) mark of conformity;
- i) warning statement: read the instructions before use; the strap must be fastened securely during use; stop using the helmet after the helmet has experienced a severe blow; corrosive solvents must not be used to clean the helmet; proper wearing of the sports helmet can effectively reduce sports injuries, but cannot completely avoid injuries.

### **7.2 Packaging, transportation and storage**

7.2.1 The contents of the packaging mentioned in Article 7.1 must also be marked on the packaging of the product.

7.2.2 During the transport and storage of the product, there should be an indication that collision and contact with moisture must be avoided, as well as corrosion from organic chemical articles.

## **8 Product instruction**

There should be a copy of a user's instruction in Chinese attached with each helmet and the instruction should include at least the following information:

- a) remind the customer to choose a certified helmet which is suitable to his own headform and size when purchasing;
- b) the strap must be fastened securely during use;
- c) if the helmet has experienced a server collision, it should not be used or the helmet must be inspected and identified if it can be used;
- d) pay attention to the helmet maintenance - corrosive solvents must not be used to clean the helmet and must not impact the helmet;
- e) the service life of the helmet should be declared by the manufacturer in accordance with the condition of the product;
- f) the structure of the helmet must not be modified;
- g) the proper wearing of the sports helmet can be effective in reducing sports injuries, but cannot prevent injuries completely.